

1890.
NEW ZEALAND.

EXAMINATION - PAPERS FOR MINE - MANAGERS' CERTIFICATES

(COPIES OF).

Return to an Order of the House of Representatives, No. 14, dated the 27th June, 1890.

Ordered, "That a copy of the examination-papers for mine-managers' certificates be laid before this House."—
(Mr. ALLEN.)

QUESTIONS TO BE USED IN EXAMINATION OF MINING MANAGERS FOR CERTIFICATES OF COMPETENCY UNDER "THE MINING ACT, 1886."

FIRST DAY (9 a.m. to 12 noon).

Subject 1.—The laying-out and construction of shafts, chambers, main drives or levels, uprisings, and stopes:—

(a.) Describe the method you would adopt in sinking a shaft through quicksand, and also show by sketch the appliances you would use in sinking.

(b.) Show by sketch what is meant by chambers and adit-levels, and also give the dimensions of same, and state what distance you consider adit-levels should be apart to work a lode advantageously, and give your reasons for the distance so mentioned.

(c.) State the dimensions of uprisings or passes to work a lode, and the distance that they should be apart, giving reasons for same.

(d.) Show by sketch how you would open out from a shaft to work alluvial ground, and also show how you would block out the ground from the main adit-level; and state at what level in relation to wash-drift you would construct the main adit-levels.

(e.) Show by sketch the approved method of stoping out lodes, and state your opinions as to the best method of stoping in order to get as many workmen employed advantageously as possible.

Subject 2.—The various methods adopted in timbering shafts and mines, and in filling in old workings:—

(a.) In commencing to timber a shaft, state how you proceed to place the first set of timber in, and the necessary precautions that have to be taken to keep the shaft truly vertical, and to keep it from twisting or winding. Also state the thickness of planking necessary for timbering a shaft having two partitions for winding, one for pumps, and one for ladder-shaft, giving the dimensions of winding-shafts suitable to work cages, the ladder-shaft, and also the dimensions of a shaft to place a 12in. column of pumps, having three different lifts and a tank placed at change of lifts in the shaft.

(b.) Show by sketch how you would timber a shaft with planking and also with frames, and also show how you would fix the partitions in the shaft and guides for working cages.

(c.) Show by sketch how you would chamber a shaft at the change of lifts in the event of its not being of sufficient dimensions, in order to make room for pumps being placed in position.

(d.) How do you ascertain the strength of beams and timber used in a mine? Suppose a beam of red-pine 10in. broad and 14in. deep, with 8ft. between the supports, what would be its breaking-strength assuming it to be loaded at the centre of the span, and also if it were uniformly loaded?

(e.) If a prop of round totara timber were required 6ft. long to support a load of 20 tons, what diameter would it require to be to support this weight?

(f.) If you had to construct an adit-level through soft pug, show by sketch how you would timber it.

(g.) In constructing an adit-level, if you met with quicksand what precautions would you adopt, and how would you proceed to carry the adit through the quicksand?

(h.) State how you would timber passes, and what provision you would make to allow the workmen to get up and down from the stopes.

(i.) If you were constructing adits through loose or heavy ground liable to run, what precaution would you adopt to secure the timber so that if one set broke down it would not carry other sets along with it?

(2 p.m. to 5 p.m.)

Subject 3.—The drainage of mines, and pumping-appliances:—

(a.) Show by sketch the method of fixing supports in shafts for pumps and rising mains.

(b.) Show by sketch how you would arrange the lifts in an 18in. pumping-plant consisting of five lifting sets and one forcing set, the shaft being 1,000ft. deep and the water to be pumped to the surface.

(c.) What is a balance-bob or -beam? In what position is it fitted, and for what purpose?

(d.) What is a V-bob? In what position is it fitted, and for what purpose?

(e.) What is a snifter-valve or wind-bore, where fitted, and for what purpose?

(f.) In the case of a plunger-pump, what do you consider the best relative height (as regards such pump) for the cistern from which it receives its supply?

(g.) What are the advantages of a combined plunger- and bucket-pump? Explain its action.

(h.) Required the thickness in cast-iron of a 16in. pipe for a head of water 150ft. high.

(i.) What weight of cast-iron pipes would be required for a pumping-plant, the engine and pumps being placed near the bottom of the shaft, the water being forced through a vertical column of 1,000ft., pipes 8in. diameter and 9ft. long?

(j.) Show by sketch how two complete sets of pumps are worked off one beam, side by side, the motion of the spears being in opposite directions.

(k.) How many gallons of water will be raised per hour by a combined bucket- and plunger-pump, the plunger being 10in. diameter and the working-barrel 14in., with a stroke of 6ft., giving six strokes per minute?

(l.) What is the velocity of discharge from a pump having a stroke of 10ft. and making six strokes per minute?

(m.) Describe the different methods of making joints in connection with ordinary pumps and pumps working under high pressures.

(n.) In gearing buckets and clack-valves, which side of the leather is used as the working-face?

(o.) What description of buckets and clack-valves are used in modern pumps where the pressure is high?

(p.) In splicing pump-rods and main spears should round- or square-bodied bolts be used in fixing the fish-plates, and why?

Subject 4.—The haulage in shafts and in underground planes:—

(a.) Where cages are used in which the tubs are carried one above the other, what arrangements are made at the bottom of the shaft by which the tubs in each flat of the cage may be changed at the same time?

(b.) Describe a drop-cage and its action.

(c.) What type of winding-engine requires a counterbalance weight? How is such balance-weight fitted?

(d.) What would be a safe load on a flat three- and four-linked chain having $\frac{5}{8}$ in. pins, the shearing resistance of which is 22 tons per square inch?

SECOND DAY (9 a.m. to 12 noon).

Subject 5.—On the ventilation of mines:—

(a.) What is natural ventilation? and state on what principle it is based; also state the weight of a cubic foot of air at 32° Fahr. and also at 80° Fahr.

(b.) State the composition of atmospheric air, also the composition of carbonic-acid gas and of carburetted-hydrogen gas.

(c.) State what means you would adopt to detect the presence of carbonic-acid gas, and also of carburetted-hydrogen gas, in mines.

(d.) What quantity of atmospheric air is required to mix with a cubic foot of carburetted-hydrogen gas to render it safe and harmless to the workmen employed?

(e.) If there were 4 per cent. of carbonic-acid gas in the air of a mine, what percentage of atmospheric air would be required to dilute the air and render it perfectly wholesome?

(f.) What is meant by the friction of air in air-courses, and how do you calculate it?

(g.) Suppose that 20,000 cubic feet of air was passing through an airway 6ft. by 5ft. and 1,000ft. long, and this air was divided into three divisions, and had to pass through three different air-courses with the same pressure as in the main air-course, the respective dimensions of each divisional air-course being as follow: 1st division, 5ft. $\times$ 4ft., 2,000ft. long; 2nd division, 5ft. $\times$ 3ft., 1,500ft. long; 3rd division, 5ft. $\times$ 2ft. 6in., 1,000ft. long—what quantity of air would pass through each air-course?

(h.) If natural ventilation proved insufficient, what means would you take to force atmospheric air into the mine? and explain the system you propose to adopt.

Subject 6.—Tapping water in mines, and mode of constructing dams in underground workings to keep the water back:—

(a.) If you meet with a stream of water coming through a certain stratum in the rock while sinking a shaft, what means would you adopt to dam the water back so as to prevent its going down to a lower level?

(b.) Show by sketch how you would construct a dam in an adit if the rock were solid, to keep the water back.

(c.) Describe the precautions you would take if you were approaching any place where there was a lodgment of water, and also state how you would tap the water.

(2 p.m. to 5 p.m.)

Subject 7.—On blasting and the use of explosives:—

(a.) State the manner in which you would charge a hole with explosive, and the method of tamping; also state what tools and material you would use for tamping a shot.

(b.) If a shot missed fire, what steps would you take?

(c.) What are the relative strengths of blasting-powder, dynamite, and blasting-gelatine as per unit of weight, and which of these explosives produces the largest quantity of deleterious fumes when proper combustion is effected?

(d.) How do you calculate the quantity of explosive required to do the work? Suppose a hole 2 $\frac{1}{2}$ in. in diameter were 5ft. deep, with the line of least resistance being 3ft., what quantity of dynamite would be required to be used?

(e.) If you had to use blasting-powder in wet ground, how would you charge the hole?

(f.) If dynamite was in a frozen condition, what would you do before using it, and what effect (if any) has cold on dynamite as regards its strength as an explosive?

Subject 8.—The effect that faults, slides, and mullock-bars have on lodes, and how to ascertain the direction of slides and heavals :—

(a.) In driving on a lode or reef which strikes N.E. and dips 45° to N.W., it is found to be cut off by a fault that has an underlie of 45° due W. How would you proceed to recover the lode? Explain your theory fully, with diagrams, plan, and sections.

(b.) Country rock of alternate beds of slate and sandstone, and prevailing S.E. dip, carries N.-and-S. vertical lodes, in which the ore runs in bunches or shoots. Explain the probable reason for this, giving diagram, plan, and sections.

THIRD DAY (9 a.m. to 12 noon).

Subject 9.—A knowledge of underground surveying and of making plans of the underground workings, showing the dip or inclination and strike of the reefs or lodes :—

(a.) The candidate must produce a plan showing the surface boundaries of a mining claim of at least twenty acres in extent, and also show (in different-coloured ink) the underground workings, with all traverse-lines, &c., to illustrate the method of survey adopted. Such plan and survey to be the actual work of the candidate.

(b.) Draw a diagram showing how the underground traverses have been connected with the surface traverses, and describe in writing the method adopted for so doing, and describe the apparatus used.

(c.) Produce the original field-book of the work, and also the tabulations showing the closure of the traverses, and the calculation of the distances on meridian and perpendicular.

(d.) From the two points which are farthest apart in the underground survey, calculate the bearing and distance these two points are from one another, and show the calculations.

(e.) Describe the method of obtaining the meridian used in the bearings of both surface and underground survey.

(f.) Describe the method by which the survey has been made, name the instruments used to obtain measurements and angles, and say how the measurements have been reduced to the horizontal.

(g.) What means were taken to insure the accuracy of the measuring-tape, chain, or whatever else was used?

(2 p.m. to 5 p.m.)

Subject 9 (continued) :—

(h.) In a case where magnetic bearings have been used, describe how the differences between the surface and underground meridians are obtained.

(i.) Describe the adjustments of a plane theodolite, and also describe a miner's dial, in writing. [The candidate will also be examined orally in the adjustments and use of these instruments.]

(j.) In a case where there are two adits, describe the method of obtaining the underground meridian, and its connection with the surface meridian.

(k.) Describe how the traverses on which the plan is based were plotted, and also the method by which the offsets were put in.

(l.) What is the area of a figure which is 1,040ft. long, 20ft. wide at one end and 280ft. at the other at right-angles to the line of 1,040ft.?

(m.) What is the area of a triangle 640ft. long in the base and 400ft. long on the perpendicular?

FOURTH DAY (9 a.m. to 12 noon).

Subject 10.—A knowledge of the different rocks where gold, silver, tin, copper, zinc, lead, and antimony are found, and of the formation of lodes and leads :—

(a.) What is the mineral nature of serpentine rock, and what rocks and metallic ores are usually associated with it? Give New Zealand examples.

(b.) In what rock-formations would you expect to find ores of the following metals: Silver, lead, tin, copper, zinc, antimony, manganese, chrome, and tungsten? Give New Zealand examples and localities.

(c.) Describe the different modes in which quartz occurs in veins or otherwise, and the formations in which it is likely to be auriferous to a payable degree.

*Subject 11.**—A knowledge of arithmetic and the methods of keeping accounts :—

(a.) The diameter of a circle is 8ft. : what is its (1) circumference, (2) area?

(b.) Find the square root of 4651904.

(c.) Multiply 84.79 by 88090.

(d.) Find the cost of 13 score 14 tubs, each tub containing $8\frac{1}{2}$ cwt., 20 tubs to one score, at 13s. 4d. per score of 8 tons.

(e.) The tonnage price at a colliery was 5s. ; subsequently 15 per cent. was given, then 15 per cent. reduction : what was the final rate? Afterwards it was agreed that in every ton 1cwt. should be deducted for slack, for which only 9d. per ton should be paid : what was the price per ton of the men's output?

(f.) What is the area of an airway measuring 4ft. 3in. by 3ft. 9in.?

(g.) Under what heads should a cost-sheet at a colliery be divided? Give an illustration.

Subject 12.—A knowledge of "The Mining Act, 1886."

QUESTIONS TO BE USED IN EXAMINATION OF MINING MANAGERS FOR CERTIFICATES OF COMPETENCY UNDER "THE COAL-MINES ACT, 1886."

FIRST DAY (9 a.m. to 12 noon).

Subject 1.—On the sinking of shafts and construction of main roadways, opening out a mine, and the division of a mine into districts :—

* In all cases give the details of your calculations.

- (a.) What form of shaft do you prefer, and why? Give the dimensions of a shaft suitable for raising 500 tons a day from a depth of 600ft., allowing for pumps.
- (b.) What is tubbing? Describe the process of fixing and finishing it.
- (c.) How do you secure pumps in a shaft lined with tubbing?
- (d.) Draw a sketch of a sinking-bucket, showing attachment to rope.
- (e.) Give a plan and section of a long wall stall, showing timbering.
- (f.) What is meant by dividing a mine into districts? What is to be gained by this proceeding?

Subject 2.—The various methods adopted in securing shafts and workings in a mine, showing the relative advantage and efficiency of each class of material used:—

- (a.) What materials are used for securing shafts? Under what circumstances should each be employed?
- (b.) Give sketches of timbering workings—(1) for a steep seam, and (2) for a hard roof and soft floor.
- (c.) What is the best form of timbering to resist a creep?
- (d.) Give a sketch indicating how sprags should be set.

Subject 3.—The various methods of ventilation, and the construction of airways so as to produce a good circulation of fresh air in any part of the mine:—

- (a.) Describe fully what is known as natural ventilation. Is this always to be relied on? and, if not, give the reason.
- (b.) What system of ventilation should you adopt—(1) in a fiery mine, 450ft. deep; (2) in a non-fiery mine, 2,000ft. deep?
- (c.) Which is more easy to ventilate—(1) a rise heading, or (2) a dip heading? Explain fully.
- (d.) What is a “dumb drift”? Explain its use, and state any objections to it.
- (e.) What precautions are necessary, in erecting a fan, to guard against damage from any catastrophe in the pit?
- (f.) Describe the various methods by which the air-current is measured.
- (g.) How much pressure per square foot does 3in. of water-gauge represent?
- (h.) Draw a sketch of a district in a fiery mine where the bords are 18ft. wide and the pillars 48ft. thick, showing direction of air-current.
- (i.) Describe and draw—(1) overcast, (2) ventilating-door, and (3) regulator. What are they used for?
- (j.) If you have an old working, 30ft. high, approached on each side by a road 10ft. in height, and a small blower of gas exists in the top of the large excavation, what steps would you take to prevent an accumulation of gas?

(2 p.m. to 5 p.m.)

Subject 4.—On the areas of air-ways, the velocity and divisions of air-currents, and the deductions to be made for friction:—

- (a.) At what velocity should air traverse the workings of a mine?
- (b.) What is the cause of friction of air in mines?
- (c.) In an airway measuring 9ft. by 17ft. the air travels 72ft. in nine seconds: what is the quantity passing?
- (d.) What do you understand by splitting the air? What is the advantage of this proceeding?
- (e.) What is the rubbing-surface of an airway measuring 8ft. 6in. by 9ft. 2in., and 1,150ft. in length?
- (f.) If we require to treble the quantity of air in the same airways, how much must we increase the power?
- (g.) What is the objection to small airways?
- (h.) Find the weight of a cubic foot of air at 30in. barometric pressure and 61° Fahrenheit.
- (i.) Which is preferable, an airway measuring 4ft. by 12ft. or one measuring 8ft. by 6ft.? Give your reasons.

Subject 5.—On the nature and composition of explosive and dangerous gases occurring in coal-mines, and on spontaneous combustion:—

- (a.) What dangerous gases are met with in coal-mines? Give them in the order of their specific gravities (the lightest first), and state their compositions and characteristics.
- (b.) At what point does a mixture of firedamp and air become most explosive, and how much air is required to dilute it to such a point that it will not explode at a naked light?
- (c.) What means have we of discovering the presence of light carburetted hydrogen?
- (d.) What is choke-damp? In what portions of the workings is it most likely to be found?
- (e.) What effect has the addition of carbonic-acid gas on an explosive mixture of air and firedamp?
- (f.) What is a “gob-fire” or “goaf-fire”? Give theories as to its origin. What means are usually taken to prevent these fires?
- (g.) What are the preliminary symptoms of a gob-fire?
- (h.) Recently a man descended a coal-mining shaft in which there had been for some time no ventilation, and fell back against the side, overpowered by gas. Close to the mouth of the shaft was a water-wheel driven by a race, but not available for winding. There was only one man at the top of the shaft. What ought he to have done?
- (i.) Under what circumstances, if any, will a mixture of ninety-eight parts of air and two of firedamp explode?

SECOND DAY (9 a.m. to 12 noon).

Subject 6.—On the drainage of mines, and pumping-appliances:—

- (a.) Show by sketch the method of fixing supports in shafts for pumps and rising mains.

- (b.) Show by sketch how you would arrange the lifts in an 18in. pumping-plant consisting of five lifting sets and one forcing set, the shaft being 1,000ft. deep and the water to be pumped to the surface.
- (c.) What is a balance-bob or -beam? In what position is it fitted, and for what purpose?
- (d.) What is a V-bob? In what position is it fitted, and for what purpose?
- (e.) What is a snifter-valve or wind-bore, where fitted, and for what purpose?
- (f.) In the case of a plunger-pump, what do you consider the best relative height (as regards such pump) for the cistern from which it receives its supply?
- (g.) What are the advantages of a combined plunger- and bucket-pump? Explain its action.
- (h.) Required the thickness in cast-iron of a 16in. pipe for a head of water 150ft. high.
- (i.) What weight of cast-iron pipes would be required for a pumping-plant, the engine and pumps being placed near the bottom of the shaft, the water being forced through a vertical column of 1,000ft., pipes 8in. diameter and 9ft. long?
- (j.) Show by sketch how two complete sets of pumps are worked off one beam, side by side, the motion of the spears being in opposite directions.
- (k.) How many gallons of water will be raised per hour by a combined bucket- and plunger-pump, the plunger being 10in. diameter and the working-barrel 14in., with a stroke of 6ft., giving six strokes per minute?
- (l.) What is the velocity of discharge from a pump having a stroke of 10ft. and making six strokes per minute?
- (m.) Describe the different methods of making joints in connection with ordinary pumps and pumps working under high pressures.
- (n.) In gearing buckets and clack-valves, which side of the leather is used as the working-face?
- (o.) What description of buckets and clack-valves are used in modern pumps where the pressure is high?
- (p.) In splicing pump-rods and main spears should round- or square-bodied bolts be used in fixing the fish-plates, and why?

(2 p.m. to 5 p.m.)

Subject 7.—The haulage on planes and in shafts, also the different systems of underground haulage, with horse-power required to do the work:—

- (a.) Where cages are used in which the tubs are carried one above the other, what arrangements are made at the bottom of the shaft by which the tubs in each flat of the cage may be changed at the same time?
- (b.) Describe a drop-cage and its action.
- (c.) What type of winding-engine requires a counterbalance weight? How is such balance-weight fitted?
- (d.) What would be a safe load on a flat three- and four-linked chain having $\frac{5}{16}$ in. pins, the shearing resistance of which is 22 tons per square inch?

Subject 8.—The theoretical and effective power of steam-engines and boilers; also on the strength of haulage ropes and chains:—

- (a.) What are the principal causes of the falling-off in the evaporative efficiency of boilers? What are the remedies?
- (b.) Show by sketch how you would construct the flues of Cornish, Lancashire, egg-ended, or multitubular boilers.

Subject 9.—The incrustations in steam-boilers, and the cause of same, and remedy therefor:—

- (a.) What parts of Cornish and Lancashire boilers are first affected by shortness of water? What parts are most injuriously affected by an accumulation of scale?
- (b.) In what part of Cornish and Lancashire boilers are fusible plugs fitted, and for what purpose?

Subject 10.—Tapping water in mines, and the mode of constructing dams in underground workings to keep water back:—

- (a.) What precautions are necessary while driving a heading in a locality where a waste full of water is known to exist?
- (b.) With what varieties of underground dams are you acquainted? Describe the best kind of dam for withstanding a heavy pressure of water, showing by sketches its mode of construction.

Subject 11.—Blasting, and the use of explosives:—

- (a.) What is a blown-out shot? What may cause it?
- (b.) What danger may be anticipated from a blown-out shot?
- (c.) What do you consider the safest explosive in a fiery mine?
- (d.) What kind of cartridges have been invented to guard against the possibility of flame from a shot?
- (e.) What precautions are necessary in a fiery mine before shot-firing?
- (f.) What sort of a tamping-tool ought to be used?
- (g.) Is coal-dust a proper material for tamping, and, if not, why?

THIRD DAY (9 a.m. to 12 noon).

Subject 14.—A knowledge of underground surveying, and of making plans showing system of working, inclination of seam, faults, and system of ventilation:—

- (a.) The candidate must produce a plan showing the surface boundaries of a mining claim of at least twenty acres in extent, and also show (in different-coloured ink) the underground workings, with all traverse-lines, &c., to illustrate the method of survey adopted. Such plan and survey to be the actual work of the candidate.

(b.) Draw a diagram showing how the underground traverses have been connected with the surface traverses, and describe in writing the method adopted for so doing, and describe the apparatus used.

(c.) Produce the original field-book of the work, and also the tabulations showing the closure of the traverses, and the calculation of the distances on meridian and perpendicular.

(d.) From the two points which are farthest apart in the underground survey, calculate the bearing and distance these two points are from one another, and show the calculations.

(e.) Describe the method of obtaining the meridian used in the bearings of both surface and underground survey.

(f.) Describe the method by which the survey has been made, name the instruments used to obtain measurements and angles, and say how the measurements have been reduced to the horizontal.

(g.) What means were taken to insure the accuracy of the measuring-tape, chain, or whatever else was used?

(h.) In a case where magnetic bearings have been used, describe how the differences between the surface and underground meridians are obtained.

(2 p.m. to 5 p.m.)

Subject 14 (continued):—

(i.) Describe the adjustments of a plane theodolite, and also describe a miner's dial, in writing. [The candidate will also be examined orally in the adjustments and use of these instruments.]

(j.) In a case where there are two adits, describe the method of obtaining the underground meridian, and its connection with the surface meridian.

(k.) Describe how the traverses on which the plan is based were plotted, and also the method by which the offsets were put in.

(l.) What is the area of a figure which is 1,040ft. long, 20ft. wide at one end and 280ft. at the other at right-angles to the line of 1,040ft.?

(m.) What is the area of a triangle 640ft. long in the base, and 400ft. long on the perpendicular?

(n.) Furnish a sketch of a coal-mine, showing faults (direction and throw), ventilation, and inclination of seam.

(o.) A seam dips at 1 in 8; 36 yards below this is another seam with the same inclination. It is required to connect these by means of a drive dipping 1 in 6. What length must it be?

FOURTH DAY (9 a.m. to 12 noon).

Subject 12.—The effect that faults produce in coal-seams, and how to ascertain the direction of a coal-seam when severed by a fault:—

(a.) In the main level of a 10ft. coal-seam having a south dip of 1 in 10, a fault is first met with on the dip side and lower corner of the face: how would you expect the "fault" to strike, and in which direction would the downthrow be, and how would you drive to recover the seam?

(b.) In sinking a square shaft in fairly steady measures dipping south, coal is first cut in the south-east corner of the shaft, but in continuing the sinking the seam is lost: how would you proceed to find the portion of the seam to the rise? explaining your reasons fully in the form of a report to employers.

Subject 13.—A knowledge of the composition and character of the different classes of coal, and also of the character of the rocks and formation of the country where coal is likely to be found:—

How do you distinguish the following kinds of coal: anthracite, cannel-coal, bituminous coal, pitch-coal, brown coal? giving the average composition and relative value for various purposes, giving New Zealand examples.

(2 p.m. to 5 p.m.)

*Subject 15.**—A knowledge of arithmetic, and the methods of keeping accounts:—

(a.) The diameter of a circle is 8ft.: what is its (1) circumference, (2) area?

(b.) Find the square root of 4651904.

(c.) Multiply 84.79 by 88090.

(d.) Find the cost of 13 score 14 tubs, each tub containing $8\frac{1}{2}$ cwt., 20 tubs to one score, at 13s. 4d. per score of 8 tons.

(e.) The tonnage price at a colliery was 5s.; subsequently 15 per cent. was given, then 15 per cent. reduction: what was the final rate? Afterwards it was agreed that in every ton 1 cwt. should be deducted for slack, for which only 9d. per ton should be paid: what was the price per ton of the men's output?

(f.) What is the area of an airway measuring 4ft. 3in. by 3ft. 9in.?

(g.) Under what heads should a cost-sheet at a colliery be divided? Give an illustration.

Subject 16.—A knowledge of the provisions of "The Coal-mines Act, 1886."

* In all cases give the details of your calculations.